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BY

**DIRK SCHINDLER AND GUTTORM SCHJELDERUP**

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NORWEGIAN SCHOOL OF ECONOMICS AND BUSINESS ADMINISTRATION

# Profit-shifting in Two-sided Markets\*

Dirk Schindler<sup>†</sup>     Guttorm Schjelderup<sup>‡</sup>

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## Abstract

We investigate how multinational two-sided platform firms set their prices on intra firm transactions. Two-sided platform firms derive income from two customer groups that are connected through at least one positive network externality from one group to the other. A main finding is that even in the absence of taxation transfer prices deviate from marginal cost of production. A second result of the paper is that it is inherently difficult to establish arm's length prices in two sided-markets. Finally, we find that differences in national tax rates may be welfare enhancing despite the use of such prices as a profit shifting device.

**Keywords:** Multinational enterprises, two-sided markets, profit shifting

**JEL classification:**

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<sup>†</sup>University of Konstanz and CESifo, Fach D 133, 78457 Konstanz, Germany; email: Dirk.Schindler@uni-konstanz.de; phone +49-7531-883691, fax +49-7531-884101.

<sup>‡</sup>Department of Finance and Management Science, Norwegian School of Economics and Business Administration and CESifo, Helleveien 30, 5045 Bergen, Norway; email: Guttorm.Schjelderup@nhh.no; phone: + 47-55959238, fax +47-55959350.

# 1 Introduction

Two-sided platform firms derive income from two customer groups that are connected through at least one positive network externality from one group to the other. A platform firm's pricing to each customer group reflects these externalities and therefore does not follow standard rules of pricing where marginal revenue equals marginal costs. Two-sided platform firms operate in some of the most economically significant industries such as the financial sector (card holders and merchants), the computer business (software developers and end users), and the media business (viewers/readers and advertisers). They are also internationally oriented. In the media business, for example, some of the most successful newspapers and TV channels have US, Asian and European versions of their products with independent entities located abroad providing the needed tailoring.<sup>1</sup>

In this paper we investigate how multinational two-sided platform firms set their prices on intra firm transactions. In the absence of taxes, we find that network externalities between two customer groups lead to a transfer price that differs from the marginal cost of production. International tax rate differentials may lead the transfer price to deviate even further from cost of production considerations. We also show that the transfer price may differ across importing countries depending on the strength and direction of network externalities making it in general very difficult to establish what the arm's length price is in two-sided markets. We show these results in a model where we let affiliates of a multinational firm be monopolists in order to purely focus on the tax effects at play. We model two-sidedness by allowing one network externality between the two groups of customers in order to bring forward the basic mechanism at play.

Our analysis is related to a growing literature in Industrial Organization that analyzes the price-setting behavior of firms in two-sided markets. In

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<sup>1</sup>For example BBC Europe and BBC USA (and CNN Europe and CNN US) and the newspapers Wall Street Journal with its US and European editions.

this literature a key result is that the pricing decisions in two-sided platform firms do not follow conventional pricing rules.<sup>2</sup> For example, an increase in marginal costs on one side of the market does not necessarily imply a higher price on that side of the market relative to the price on the other side. This is in contrast to conventional markets (one-sided) where marginal cost equal to marginal revenue pricing is well established as a guidance. In one-sided markets the effects of taxation are also well known both under perfect and imperfect competition. To the best of our knowledge there does, however, not exist any paper on two-sidedness and transfer pricing.

Our paper also relates to the literature on transfer pricing in one-sided markets. This literature finds substantial evidence for tax-motivated transfer pricing and that transfer pricing depends on differences in statutory tax rates.<sup>3</sup> Grubert and Mutti (1991) and Hines and Rice (1994) analyze the aggregate reported profitabilities of U.S. affiliates in different foreign locations in 1982. Both studies find strong indirect evidence for transfer pricing in that high taxes reduce the reported profitability of local operations. Collins, Kemsley and Lang (1998) study a pooled sample of U.S. multinationals and find that ‘normalized’ reported foreign profitability exceeds U.S. profitability among firms facing foreign tax rates below the U.S. rates. In Europe, Weichenrieder (1996) presents evidence that German firms have taken advantage of the low Irish tax rate in the manufacturing sector by shifting the returns to financial assets (“passive income”) to its subsidiaries in Ireland. Subsequent German tax legislation that restricted the ratio of passive to active income that could be earned in a foreign country led to a shift from financial to real investment in Ireland, in order to relax the new constraint. Langli and Saudagaran (2004) study small and medium sized foreign controlled corporations in manufacturing, wholesale and retail industries in Norway in the period 1993-96 using simple regression techniques. They find that these

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<sup>2</sup>See for instance Rochet and Tirole (2003, 2004).

<sup>3</sup>For a survey of this literature, see Hines (1999).

firms report consistently lower taxable income than domestically controlled corporations.

In presenting our model, Section 2 sets out the basic model while section 3 investigates transfer pricing incentives. Section 4 concludes.

## 2 The Model

We consider a multinational (parent) platform firm (MNC) that is headquartered in country  $i$  and owns subsidiaries in  $j = 1, \dots, n$  countries. The parent firm produces two goods, good  $a$  is sold worldwide by the parent firm whilst good  $x$  is sold to each affiliate  $j$  at transfer price  $q_j$ . Each affiliate determines how much of good  $x$  it purchases by maximizing its own profit. How much each affiliate buys from the parent is then a function of the transfer price and local market conditions. We shall assume that both the parent firm and the affiliates are monopolists in their respective markets, and that production costs are zero. Both assumptions are widely used in the literature and are known to bring forward the tax incentives of transfer pricing without affecting the results qualitatively.<sup>4</sup>

Affiliate  $j$  sells good  $x_j$ , where the (inverse) demand function is  $p_j = p(x_j)$ , and pays a transfer price  $q_j$  (per unit sold) to the parent firm. Good  $x$  and good  $a$  are linked by a positive externality from consumption in the following manner:  $\frac{\partial p^A(x_1, \dots, x_n, a)}{\partial x_j} > 0 \forall j$ . This means that the willingness to pay for good  $a$  is rising in the sale of good  $x$ . The parent firm derives revenue from the sale of good  $a$  and good  $x$ , but incur convex concealment costs  $C(q_j)$ , if the transfer price deviates from the true cost of production (i.e., if  $q_j \neq 0$ ). The cost function has the standard properties of  $C(0) = 0$  and  $C'(q_j) > 0$  if  $q_j \neq 0$ .

Corporate tax rates differ across countries ( $t_i \neq t_j$ ) and we assume that

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<sup>4</sup>Note that in this setting the arm's length price would be zero reflecting that this is the marginal cost of production.

the exemption method is in place. This is a reasonable assumption since it is widely used in most OECD countries and it implies that repatriated profit income is exempt from taxation.

Profits by the parent firm after corporate taxes are

$$\pi_i^H = (1 - t_i) \cdot \left\{ p^A(x_1, \dots, x_n, a) \cdot a + \sum_j q_j \cdot x_j - \sum_j C(q_j) \right\}, \quad (1)$$

whereas the after tax profits of an affiliate  $j$  are

$$\pi_j = (1 - t_j) \{ p_j(x_j) x_j - q_j x_j \}. \quad (2)$$

**Optimal Quantities** Each affiliate determines how much it sells in its local market by maximizing

$$\max_{x_j} \pi_j \quad (3)$$

and the first order condition to this maximization problem is

$$\frac{\partial p_j}{\partial x_j} \cdot x_j + p(x_j) - q_j = 0 \quad \Rightarrow \quad x_j^* = x_j(q_j), \quad (4)$$

which can be written on elasticity form as

$$p(x_j) \cdot \left[ 1 + \frac{1}{\epsilon_{x,p}^j} \right] = q_j, \quad (5)$$

where  $\epsilon_{x,p}^j = \frac{\partial x_j}{\partial p_j} \frac{p_j}{x_j}$  is the price elasticity of demand for good  $x_j$ .

Comparative statics on equation (4) yield

$$\frac{\partial x_j}{\partial q_j} = \frac{1}{\frac{\partial^2 p_j}{\partial x_j^2} + 2 \cdot \frac{\partial p_j}{\partial x_j}} < 0, \quad (6)$$

where the denominator is negative from the second order condition of the maximization problem.

The parent firm determines the optimal quantity of good  $a$  by maximizing

$$\max_a \pi_i^H \quad (7)$$

and associated first order condition is

$$\frac{\partial p^A}{\partial a} \cdot a + p^A(x_1, \dots, x_n, a) = 0 \quad \Rightarrow \quad a^* = a(x_1(q_1), \dots, x_n(q_n)). \quad (8)$$

### 3 Transfer Pricing

The optimal transfer price  $q_j$  in country  $j$  follows from maximizing MNC's world-wide profits after taxation  $\Pi$ , that is

$$\max_{q_j} \Pi = \pi_i^H(q_1, \dots, q_n) + \sum_j \pi_j(q_j),$$

Inserting for the profit function values we maximize

$$\begin{aligned} \Pi = & (1 - t_i) \cdot \left\{ p^A(x_1(q_1), \dots, x_n(q_n), a^*) \cdot a^* + \sum_j [q_j \cdot x_j(q_j) - C(q_j)] \right\} \\ & + \sum_j (1 - t_j) \{ p_j(x_j(q_j)) \cdot x_j(q_j) - q_j \cdot x_j(q_j) \}. \end{aligned} \quad (9)$$

The first order conditions are given by

$$(1 - t_i) \cdot \left\{ \frac{\partial p^A}{\partial x_j} \cdot \frac{\partial x_j}{\partial q_j} \cdot a^* + q_j \cdot \frac{\partial x_j}{\partial q_j} - C'(q_j) \right\} + (t_j - t_i) \cdot x_j(q_j) = 0 \quad \forall j. \quad (10)$$

In order to determine a benchmark result we shall assume the absence of any network externalities and that taxes are equal ( $t_i = t_j$ ). In this case the first order conditions above reduce to

$$q_j \cdot \frac{\partial x_j}{\partial q_j} - C'(q_j) = 0 \quad \Rightarrow \quad q_j^* = 0 \quad \forall j. \quad (11)$$

With sufficiently convex concealment costs it is straightforward to show that equation (11) can only be satisfied if  $q_j = 0$ . Thus, in the absence of any externality or tax motive for transfer pricing the firm sets a price equal to marginal cost of production. This is in fact the transfer price that would have been chosen between independent parties in a competitive economy.

In the presence of the network externality, but with equal taxes, the first order conditions become

$$\left[ \frac{\partial p^A}{\partial x_j} \cdot a^* + q_j \right] \cdot \frac{\partial x_j}{\partial q_j} = C'(q_j) \quad \forall j \quad (12)$$

from which it is seen that  $q_j^* < 0$  as long as  $\frac{\partial x_j}{\partial q_j} < 0$ , because  $C'(q_j) \geq 0$ . The transfer price is now below the marginal cost of production since each affiliate neglects the positive externality that the sale of good  $x_j$  has on the sale of good  $a$ . In order to remedy this failure the parent firm sets a subsidy that internalizes the externality between the two customer groups.

This result extends and strengthens an argument made by Hirshleifer (1956), who examines optimal transfer pricing rules in various settings, but in absence of taxation. The optimal transfer price normally equals marginal costs of the intermediate product, as long as demand independence prevails. However, in case of “technological dependence” (i.e., the output levels of related products affecting each others’ production costs), he states that internalizing this kind of interactions calls for “subsidies” or “taxes” on the transfer price causing a deviation from (pure) marginal costs. However, he neither formally shows this nor rigorously proves it. With respect to transfer-pricing, two-sidedness and its externalities on the willingness to pay, running from one customer group to the other, can be seen as analog to technological dependence. Our analysis shows formally, how these externalities should be incorporated in the optimal transfer-price and thereby confirms the conjecture in Hirshleifer (1956, section F).

Note that in our set-up the transfer price chosen in the absence of taxes as



given by equation (12) is (potentially) welfare-enhancing because it increases the quantities sold of good  $a$  and of good  $x_j$ .<sup>5</sup> Transfer pricing is normally considered to be harmful or at best neutral (if there is no tax motive), but as demonstrated here the cost of tax evasion should be weighed against the benefit of lower prices and a larger quantity sold.

Examining the tax motive and the externality motive together, the (implicit) formula for the optimal transfer price is

$$\frac{C''(q_j)}{x_j^*} = \frac{q_j}{x_j^*} \frac{\partial x_j}{\partial q_j} \cdot \left( 1 + \frac{p^A \cdot a^*}{q_j \cdot x_j^*} \cdot \frac{x_j^*}{p^A} \frac{\partial p^A}{\partial x_j} \right) + \frac{t_j - t_i}{1 - t_i} \quad \forall j. \quad (13)$$

In line with most of the literature and without consequence for our qualitative results let the concealment costs be quadratic in the transfer price and linear in the quantity sold, that is  $C(q_j) = \frac{q_j^2}{2} \cdot x_j$ . Using this in equation (13), we obtain

$$q_j^* = \epsilon_{x_j q_j} \cdot \left( 1 + \frac{p^A \cdot a^*}{q_j^* \cdot x_j^*} \cdot \eta_{p^A x_j} \right) + \frac{t_j - t_i}{1 - t_i} \quad \forall j, \quad (14)$$

where  $\epsilon_{x_j q_j} = \frac{q_j}{x_j} \frac{\partial x_j}{\partial q_j}$  represents the transfer price elasticity of good  $x_j$  and  $\eta_{p^A x_j} = \frac{x_j}{p^A} \frac{\partial p^A}{\partial x_j}$  can be interpreted as the elasticity of complementarity between willingness to pay for good  $a$  and sales of good  $x_j$ .

As can be seen from equation (14) the transfer price will in general differ from marginal cost even when taxes are equal. In particular, the higher the transfer price elasticity ( $\epsilon_{x_j q_j}$ ), the more negative is the transfer price. The size of the transfer price also depends positively on the network externality ( $\eta_{p^A x_j}$ ). A large network externality means a large distortion on the transfer price relative to the marginal cost of production. As seen from (14), the tax saving motive may go in the opposite direction of the network externality effect bringing the price closer to marginal cost.

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<sup>5</sup>In fact, the network externality can even cause oversupply of both goods compared to the social optimum, as will be argued later.

In general, our analysis shows that a *positive* externality will lead to a downward pressure on the transfer price relative to its “true” price. Similarly, it is straightforward to show that a *negative* externality would have the opposite effect. In some two-sided markets, several externalities could be present at the same time, and it is then the combined interactive effect of these that determines the influence on the transfer price.

The OECD model double tax convention states that the arm’s length price is the price that would have been chosen between independent trading parties. In the presence of network externalities, this approach causes at least three problems. First, two-sided platform firms exist because they internalize externalities between two customer groups. Such firms do not in general trade with each other due to the nature of the business they are in. This makes it hard to determine a market price. Second, in such markets it is unlikely to observe firms that only serve one customer group, since the very fact that two-sided platform firms exist in a market is an indication of that this is a superior mode of business. Third, examining the price of transactions between two customer groups in different platform firms is also an odd basis for establishing the market price since our analysis shows that such prices are firm specific and depend on the size and direction of the externalities in question.

Another interesting result that follows from equation (14) is that despite the presence of profit-shifting, a tax-distorted transfer price may have a positive effect on welfare. Kind et al (2008) show that a two-sided monopoly platform firm may produce *too much* of both goods compared to the social optimum when there are positive intergroup externalities. In the model by Kind et al (2008) there is no profit shifting motive at play. As our analysis has shown, introducing transfer pricing will increase the possibility of over-supply if the tax rate differential has the same sign as the network externality, since this would lower the transfer price even further. However, if international differences in tax rates (and thus the motive of profit shifting) work

against the network externality, profit-shifting will ceteris paribus increase the transfer price and, consequently, mitigate the oversupply problem.

It is straightforward to show the effect of changes in either tax rate on the transfer price. In particular, we obtain

$$\frac{dq_j}{dt_j} = -\frac{x_j^*/(1-t_i)}{\left(\frac{\partial p^A}{\partial x_j} \cdot a^* + q_j\right) \cdot \frac{\partial^2 x_j}{\partial q_j^2} + \left(1 + \frac{t_j-t_i}{1-t_i}\right) \cdot \frac{\partial x_j}{\partial q_j} - C''(q_j)} > 0, \forall j \quad (15)$$

$$\frac{dq_j}{dt_i} = \frac{(1-t_j)x_j^*/(1-t_i)^2}{\left(\frac{\partial p^A}{\partial x_j} \cdot a^* + q_j\right) \cdot \frac{\partial^2 x_j}{\partial q_j^2} + \left(1 + \frac{t_j-t_i}{1-t_i}\right) \cdot \frac{\partial x_j}{\partial q_j} - C''(q_j)} < 0, \forall j, \quad (16)$$

because the denominator in both expressions is negative from the second order condition for an optimal transfer price  $q_j$ .

Recall that the parent firm produces two goods, where good  $a$  is sold worldwide by the parent firm whilst good  $x$  is sold to each affiliate  $j$  at transfer price  $q_j$ . The parent firm faces the tax rate  $t_i$  so an increase in tax rates facing the affiliates ( $t_j$ ) means that it becomes more profitable to shift profit to the parent firm, which is done by overinvoicing the transaction. Similarly, a higher  $t_i$  means that it has become more attractive to shift profit to the affiliates by underinvoicing.

Finally, we can define  $\alpha_j = \frac{\partial p^A}{\partial x_j} \cdot a^*$  as the magnitude of the externality and interpret an increase in  $\alpha_j$  either as a shift in preferences for good  $a$  or as an increase in the network externality between goods  $a$  and  $x_j$ . The effect on the transfer price of a change in  $\alpha_j$  is

$$\frac{dq_j}{d\alpha_j} = -\frac{\partial x_j / \partial q_j}{\left(\frac{\partial p^A}{\partial x_j} \cdot a^* + q_j\right) \cdot \frac{\partial^2 x_j}{\partial q_j^2} + \left(1 + \frac{t_j-t_i}{1-t_i}\right) \cdot \frac{\partial x_j}{\partial q_j} - C''(q_j)} < 0 \forall j \quad (17)$$

where the negative sign follows from  $\frac{\partial x_j}{\partial q_j} < 0$ , equation (10), and the negativity of the second order condition. The intuition is that if the marginal willingness to pay for good  $a$  is rising in the amount sold of good  $x_j$ , then

it pays for the multinational firm to let the parent firm subsidize the sale of good  $x_j$  by selling at an even lower transfer price  $q_j$ .

Note that the magnitude of the externality and the elasticity of complementarity  $\eta_{p^A x_j}$  will vary between countries, making the firm set different transfer prices across countries. These international differences need not reflect differences in international tax rates but may be entirely due to the differences in demand across countries. This goes to show that it is not easy to establish what the correct transfer price is even in the absence of taxation.

## 4 Concluding Remarks

This paper has demonstrated that multinational two-sided platform firms set transfer prices that deviate from the marginal cost of production even in the absence of taxation. We also show that the transfer price may be welfare enhancing even if differences in national tax rates give rise to profit-shifting. If the tax rate differential mitigates the externality effect, the total effect on welfare is ambiguous. Nevertheless, it may be that reducing (potential) oversupply overcompensates losses from tax-evasion.

Out of our analysis also comes the insight that in the absence of taxation the transfer price on the same transaction will differ across countries depending on the strength of demand specific network externalities between customer groups. According to the OECD double tax convention: “... the correct transfer price is the price that would have been chosen if the transaction had occurred between independent agents in the market place ... (i.e., the arm’s length price)”.<sup>6</sup> Our analysis points to that in two-sided markets arm’s length prices may be difficult or even impossible to establish. There are several reasons for this. First, two-sided platform firms may find it profitable to charge prices that are below marginal cost or even negative for one product (customer group). Second, in such markets where the transfer price

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<sup>6</sup>OECD double taxation convention, 1977.

serves to internalize the externality between customer groups, there may not exist market parallels that can be used, and if they did exist, they could be from firms serving only one customer group (i.e., a one-sided market firm). Such firms face very different pricing incentives and cannot be used for price comparisons.

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